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(54) ELECTROPHOTOGRAPHIC DEVELOPING CARRIER, TWO-COMPONENT DEVELOPER AND IMAGE FORMING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a sharp image having excellent gradation without causing an edge effect, decrease in the image density and fog even when a color original in a large image size is continuously copied and to maintain a sharp image even after lots of images are copied.

SOLUTION: This carrier is produced by adding a capacitor component on the surface of magnetic carrier core particles having a ferrite component expressed by the formula $(\text{Fe}_2\text{O}_3)_x(\text{A})_y(\text{B})_z$ in such a manner that the electrostatic capacitance of the carrier determined by the measurement of the dependence of the impedance on the frequency of voltage applied under conditions of sinusoidal AC voltage with 2KV amplitude is between ≥ 10 -15F and ≤ 10 -11F. In the formula, A represents MgO, AgO₂ or their mixture, B represents Li₂O, MnO, CaO, SrO, Al₂O₃, SiO₂ or their mixture, and (x), (y), (z) are weight ratios satisfying $0.2 \leq x \leq 0.95$, $0.005 \leq y \leq 0.3$, $0 < z \leq 0.795$, and $x+y+z \leq 1$, respectively.

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CLAIMS

[Claim(s)]

[Claim 1] Ferrite component shown by the following formula (I) $(\text{Fe}_2\text{O}_3)_x(\text{A})_y(\text{B})_z$ Formula (I) [-- the inside of a formula, and A -- MgO, Ag₂O, or those mixture -- being shown -- B -- Li₂O, and MnO, CaO, SrO and aluminum₂ -- O₃, SiO₂, or those mixture -- being shown -- x, and y and z -- a weight ratio -- being shown -- and the following conditions $0.2 \leq x \leq 0.95$ and $0.005 \leq y \leq 0.3$, $0 < z \leq 0.795$, and $x+y+z \leq 1$ are satisfied.] The carrier for electrophotography development with which electrostatic capacity of the carrier obtained from the applied-voltage frequency dependent of the impedance which gives a capacitor capacity component to the magnetic carrier core material particle front face which ****, and is measured under sine alternating voltage with an amplitude width of 2kV is characterized by being a value not more than more than 10-15F10-11F.

[Claim 2] In the binary system developer which has a toner and a carrier at least, this carrier is a carrier according to claim 1. This binary system developer has the impedance of 1.2×10^8 or more ohm-cm under an amplitude width of 2kV, and sine alternating voltage with a frequency of 2kHz. And the binary system developer characterized by the capacity of this developer obtained from the applied-voltage frequency dependent of the impedance measured under sine alternating voltage with an amplitude width of 2kV being a value not more than more than 10-14F10-11F.

[Claim 3] Both a magnet roller and developer support are rotated among the magnet rollers built in developer support and this. Fix a magnet roller, rotate developer support, carry out circulation conveyance of the binary system developer which contains a carrier and a toner at least on developer support, and in or the development field of a latent-image supporter and the developer support which counters it In the image formation approach which imprints the toner image which developed the latent image with the toner and was formed on the latent-image supporter on imprint material The image formation approach characterized by for this binary system developer forming the mutual electric field which are developers according to claim 2 and have the alternating current component and the dc component in this development field, and developing a latent image on the conditions whose frequency ν (Hz) of this mutual electric field are $1.0 \leq \nu$.

[Claim 4] Both a magnet roller and developer support are rotated among the magnet rollers built in developer support and this. Fix a magnet roller, rotate developer support, carry out circulation conveyance of the binary system developer which contains a carrier and a toner at least on developer support, and in or the development field of a latent-image supporter and the developer bearing body which counters it In the image formation approach which imprints the toner image which developed the latent image with the toner and was formed on developer support on imprint material This binary system developer is a developer according to claim 2, and the development by this toner between a latent-image supporter and developer support After impressing the electrical potential difference which draws a toner near to a developer bearing body from a latent-image supporter, and the electrical potential difference which makes it fly from developer support to a latent-image supporter once [T / at least] for 1 hour The image formation approach characterized by being made by impressing the electrical potential difference of the direction which a toner is made to fly to the image section and pulls back a toner to the non-image

section.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the binary system developer using the carrier and this carrier which constitute the binary system developer which especially improved endurance, image quality, and environmental capability remarkably, and the image formation approach using the binary system developer about the binary system developer using the carrier and this carrier which constitute the binary system developer used for developing an electric latent image or a magnetic latent image in a xerography or an electrostatic printing method.

[0002]

[Description of the Prior Art] The carrier which constitutes a binary system developer is divided roughly into a conductive carrier and an insulating carrier, and the iron powder which is not oxidized [oxidation or] is usually used as a conductive carrier. In the binary system developer which uses this iron powder carrier as a component, the frictional electrification nature to a toner is unstable, and the trouble referred to as being easy to generate fogging is in the visible image therefore formed. That is, a bias current falls, since it follows on use of a binary system developer and a toner particle is adhered and accumulated in the front face of an iron powder carrier particle (SUPENTO toner), moreover, frictional electrification nature becomes unstable, the electric resistance of an iron powder carrier particle increases, and fogging increases [the image concentration of the visible image formed as a result falls, and]. therefore -- if an electronic reproducing unit copies continuously using the binary system developer containing an iron powder carrier -- few -- since a binary system developer deteriorates with the copy of several sheets, it is necessary to exchange a binary system developer at an early stage, and cost will become high after all.

[0003] Generally as an insulating carrier, the carrier which covered with insulating resin to homogeneity the front face of iron, nickel, and the carrier core material that consists of the ferromagnetic like a ferrite is typical. Compared with the case where it is a conductive carrier that a toner particle welds to a carrier front face in the binary system developer using this insulating carrier, it is remarkably few, it is easy for coincidence to control the frictional electrification nature of a toner and a carrier, it excels in endurance, and there is an advantage of being suitable for especially a high-speed electrophotography copying machine, at the point that a use life is long.

[0004] Although there are various properties demanded from this insulating carrier, electrification nature moderate as an important property, the homogeneity of the amount distribution of electrifications, endurance, the electrical property that can give high definition can be mentioned especially.

[0005] If such demand characteristics of many are taken into consideration, the insulating carrier used conventionally has left the problem which should still be solved, and, for the moment, the perfect thing is not known.

[0006] For example, the present condition is that the physical change of front faces, such as peeling of the cladding material according [on a surface coat ferrite carrier or] to use of long duration, is not avoided, and when the amount of electrifications of a toner is being controlled especially by the cladding material, the amount of toner electrifications changes the time of the beginning of using, and after long-

term use in many cases. Therefore, that with which a high thing may still be satisfied of the electrification grant ability of a non-covered ferrite carrier core material enough sufficiently quickly is not found.

[0007] Furthermore, we are in the inclination for an electrification rate to become slow in addition to the surface area per unit weight increasing if particle size becomes fine, although the attempt in which the demand of the high definition of recent years and a copying machine and high-definition-izing is increasing in the commercial scene, particle size of a toner will be made fine in the technical field concerned, and high-definition colorization will be attained is made, and band quantity of electricity of a toner becoming large, and are just going to be anxious about durable degradation like image *****, fogging, and toner scattering.

[0008] That is, in the development of the electrostatic latent image currently held at the electrostatic latent-image supporter, it is mixed with the carrier which is a large drop child comparatively, and a toner is used as a binary system developer for electrophotography. By mutual contact friction, the presentation of both toner and carrier is chosen so that a toner may be tintured with a polarity opposite to the charge on a photoconduction layer. As a result of both contact friction, a carrier makes a toner adhere to a front face electrostatic, conveys the inside of a developer as a developer, and supplies a toner on the photoconduction layer of an electrostatic latent-image supporter.

[0009] However, although an image with clear and good image quality will be obtained in early stages if several multi-sheet continuation copy is performed by the electronic reproducing unit using such a two component developer, after tens of thousands of sheet copy has much fogging, and serves as a scarce image in the top where an edge effect is remarkable at gradation nature and clear nature.

[0010] In the color copy using a chromatic color toner, continuation story tonality is an important factor which affects image quality, and it spoils the gradation nature of an image greatly that the edge effect as which only the periphery of an image is emphasized after several multi-sheet copy arises. It looks down upon copy repeatability including the color reproduction nature in a color copy, such as forming the false profile by the edge effect near the actual profile.

[0011] Furthermore, the image area used by the conventional monochrome copy is 10% or less, as an image, like a letter, reference, and a report, also at the lowest, image area is 20% or more, and, in the color copy, the frequency or field where the solid image which has gradation nature like a photograph, a catalog, a map, and pictures also in an image is remarkable is occupied to being almost the Rhine image part.

[0012] If a continuation copy is performed using a manuscript with such a large image area, although the duplication of high image concentration is obtained the first stage, usually The toner supply to a two component developer stops meeting the deadline gradually. In the condition inadequate in electrification in a concentration fall arising Mixing with a supply toner and a carrier is made, it becomes the cause of fogging, or the change in partial toner concentration (the mixing ratio of a toner and a carrier is shown) arises on a development sleeve, and there is an inclination for the skip of an image and the uniformity of image concentration to no longer be acquired. This inclination is much more remarkable, when a toner is minor-diameter-ized.

[0013] This has bad stand going up of the prompt frictional electrification between that the toner intensive matter in a binary system developer (namely, toner concentration) is too low or a supply toner, and the carrier in a two component developer, and it is thought that these underdevelopments and fogging occur when the toner of the inadequate un-controllability amount of electrifications participates in development.

[0014] The capacity which can always output the image of right image quality with the continuous copy of the manuscript of large image area as a color developer is indispensable. In order to cope with a manuscript with very much [conventionally / area / image area is large and] toner consumption, many corresponded by amelioration of a developer rather than the own amelioration of a developer. That is, in order to raise the contact opportunity to the electrostatic latent image of a development sleeve, the peripheral speed of a development sleeve is brought forward, or making magnitude of a development sleeve into the thing of the diameter of macrostomia etc. is performed.

[0015] Although these cures raise development capacity, it produces them that an equipment life receives a limit remarkably by the contamination to the inside of a plane by toner scattering from a developer and the overload to a developer drive etc. Furthermore, although it may correspond by supplying a lot of developers in a developer in order to compensate the development deficiency in performance of a developer, it results in causing the overload to a developer drive etc. like the cost rise by the weight increase of the whole equipment, and enlargement of equipment, and ****, and is not not much desirable, and these are also still important for the amelioration from a carrier.

[0016] On the other hand, since an insulating carrier is high resistance as compared with an iron powder carrier, when it is used as a developer for electrophotography, in order not to disturb an electrostatic latent image, the repeatability of a thin line image and a highlights image becomes very good, and becomes possible [obtaining a high definition image].

[0017] however -- although it is high resistance -- means -- the time of development -- an edge effect -- generating -- easy -- being the so-called -- white -- it NUKE, or sweeps and brings near and a ***** image defect is produced. Since development field strength furthermore falls, the amount of toner development and the problem that image concentration will also fall as it is are also generated.

[0018] In order to solve such problems, conventionally various efforts have been made.

[0019] For example, in JP,52-154639,A or JP,2-160259,A, control of an edge effect is tried by using the carrier core material of low resistance. However, when a low resistance carrier core is used, it becomes difficult [it / to obtain the above-mentioned high definition image], and also the latent-image potential fall of the non-image section arises by charge impregnation to the latent image by the impression bias at the time of development, and it is easy to generate the phenomenon called so-called fogging.

[0020] Moreover, as shown, for example in JP,62-280756,A, to use the carrier which covered the carrier core material front face with the polymer containing conductive impalpable powder, and made the electric resistance of the front face of a carrier low is also tried. However, when a carrier with such low surface electric resistance is used, the so-called carrier adhesion in which this carrier adheres to a latent-image supporter front face arises, and also the charge impregnation to a latent image will become more remarkable, and the remains of soak and the so-called white Poti will occur on an image.

[0021] Then, in JP,5-181319,A, using the carrier core which limited the range of electric resistance is indicated.

[0022] However, it is by carrying out and it is [difficulty or] ** to obtain the carrier with which it is satisfied of the opposite function of control of highly minute image reappearance and an edge effect enough, even if it uses such carrier cores.

[0023] In addition, as point ** was carried out, in order to attain high-definition colorization in the technical field concerned, diameter-ization of a granule of a toner is progressing. Although the further diameter-ization of a granule of a carrier is also tried for the purpose of the improvement in development effectiveness When dealing with the amount change of electrifications by the environment or durability becomes still more difficult and uses it as a developer for high-definition colors especially, the actual condition is that a carrier for electrophotography development with which it is fully satisfied of all image properties, the electrification properties, and endurance is desired eagerly.

[0024]

[Problem(s) to be Solved by the Invention] The purpose of this invention is to offer the image formation approach using the binary system developer and this binary system developer using the carrier and this carrier which constitute the binary system developer which solved the trouble like ****.

[0025] That is, even if the purpose of this invention performs the continuation copy of the color copy of large image area, it is to offer the image formation approach using the binary system developer and this binary system developer using the carrier and this carrier which constitute the fall of image concentration, and the binary system developer which a skip does not produce.

[0026] The further purpose of this invention is to offer the image formation approach using the binary system developer and this binary system developer using the carrier and this carrier which constitute the binary system developer which is excellent in gradation nature, and has a clear image property without fogging or an edge effect, and was excellent in durable stability.

[0027] Another purpose of this invention is to offer the image formation approach using the binary system developer and this binary system developer using the carrier and this carrier which constitute the binary system developer with which the prompt start of the frictional electrification between a toner and a carrier is obtained.

[0028] Another purpose of this invention is to offer the image formation approach using the binary system developer and this binary system developer using the carrier and this carrier which constitute a binary system developer with few environmental dependencies of frictional electrification.

[0029]

[Means for Solving the Problem and its Function] This invention is a ferrite component shown by the following formula (I). $(\text{Fe}_2\text{O}_3)_x(\text{A})_y(\text{B})_z$ Formula (I)

[-- the inside of a formula, and A -- MgO, Ag₂O, or those mixture -- being shown -- B -- Li₂O, and MnO, CaO, SrO and aluminum₂ -- O₃, SiO₂, or those mixture -- being shown -- x, and y and z -- a weight ratio -- being shown -- and the following conditions $0.2 \leq x \leq 0.95$ and $0.005 \leq y \leq 0.3$, $0 < z \leq 0.795$, and $x+y+z \leq 1$ are satisfied.] A capacitor capacity component is given to the magnetic carrier core material particle front face which ****, and the electrostatic capacity of the carrier obtained from the applied-voltage frequency dependent of the impedance measured under sine alternating voltage with an amplitude width of 2kV is related with the carrier for electrophotography development characterized by being a value not more than more than 10-15F10-11F.

[0030] Furthermore, this invention is set to the binary system developer which has a toner and a carrier at least. This carrier is a carrier given in the above, and this binary system developer has the impedance of 1.2×10^8 or more ohm-cm under an amplitude width of 2kV, and sine alternating voltage with a frequency of 2kHz. And it is related with the binary system developer characterized by the capacity of this developer obtained from the applied-voltage frequency dependent of the impedance measured under sine alternating voltage with an amplitude width of 2kV being a value not more than more than 10-14F10-11F.

[0031] Furthermore, the inside of the magnet roller by which this invention was built in developer support and this, Rotate both a magnet roller and developer support, or fix a magnet roller and developer support is rotated. Carry out circulation conveyance of the binary system developer which contains a carrier and a toner at least on developer support, and in the development field of a latent-image supporter and the developer support which counters it In the image formation approach which imprints the toner image which developed the latent image with the toner and was formed on the latent-image supporter on imprint material This binary system developer forms in the above the mutual electric field which are the developers of a publication and have the alternating current component and the dc component in this development field, and it is related with the image formation approach characterized by developing a latent image on the conditions whose frequency nukHz(es) of this mutual electric field are $1.0 \leq \nu$.

[0032] Furthermore, the inside of the magnet roller by which this invention was built in developer support and this, Rotate both a magnet roller and developer support, or fix a magnet roller and developer support is rotated. Carry out circulation conveyance of the binary system developer which contains a carrier and a toner at least on developer support, and in the development field of a latent-image supporter and the developer support which counters it In the image formation approach which imprints the toner image which developed the latent image with the toner and was formed on the latent-image supporter on imprint material To the above, this binary system developer is a developer of a publication, and the development by this toner between a latent-image supporter and developer support After impressing the electrical potential difference which draws a toner near to developer support from a latent-image supporter, and the electrical potential difference which makes it fly from developer support to a latent-image supporter once [T / at least] for 1 hour A toner is made to fly to the image section and it is related with the image formation approach characterized by being made by impressing the electrical potential difference of the direction which pulls back a toner to the non-image section.

[0033] When this invention person etc. inquired wholeheartedly that the above-mentioned conventional trouble should be improved and the magnetic carrier core material particle which contains first the

magnetic-substance component shown by the above-mentioned formula (I) was used, he found out an image property, an electrification property, and that endurance also improved sharply further.

[0034] Furthermore, by giving the capacitor component which has the electrostatic capacity of specific within the limits in this magnetic carrier core material particle front face, in addition to a high definition image without an edge effect, that an image with very high gradation nature is obtained also finds out, and it came to complete this invention.

[0035] In the above-mentioned formula (I), that x , and y and z satisfy following conditions $0.2 \leq x \leq 0.95$, $0.005 \leq y \leq 0.3$, $x+y < 1$, and $z = 1-x-y$ more preferably A carrier core material particle has moderate surface irregularity, and have moderate content moisture, and although it is desirable in the point of coexistence of the adhesion of resin, and tough nature, it sets to this invention. Other metallic elements are aimed at adjustment of the diameter of crystal grain of a magnetic carrier core material particle front face in 3 or less % of the weight of the range which does not bar the effectiveness which the above-mentioned ferrite component has. You may make it contain with the gestalt of a hydroxide, an oxide, a sulfide, or a fatty-acid compound in a magnetic ferrite component as a particle-size-distribution regulator for the purpose of the coalescence prevention at the time of baking.

[0036]

[Embodiment of the Invention] In the above-mentioned formula (I), when magnetic properties become low and it is easy to produce the blemish of scattering of a carrier, or the front face of a photo conductor, when x is less than 0.2, and x exceeds 0.95, resistance of a core material tends to become low. When resistance and magnetic properties proper when y is less than 0.005 are hard to be acquired and y exceeds 0.3, it may be able to stop being able to attain homogenization and balling-up on a carrier particle front face. When z is 0 (i.e., when (B) is not contained), it is hard to obtain the thing of sharp particle size distribution, and it becomes intense difficultly the blemish on the front face of a photo conductor by the superfines of a carrier or uniting carrier manufacture at the time of baking. When z exceeds 0.795, magnetic properties become low and scattering of a carrier gets worse.

[0037] moreover, $x+y+z$ does not necessarily need to be 1, and, other than this, may be boiled, and other metallic oxides or compounds may contain it in the range which does not spoil the property of a carrier core material (namely, $x+y+z < 1$).

[0038] As for x , and y and z , in the above-mentioned formula (I), it is more desirable to satisfy the following conditions.

[0039]

$0.4 \leq x \leq 0.9$, $0.01 \leq y \leq 0.25$, $0.01 \leq z \leq 0.2$, $x+y+z \leq 1$ [0040] Furthermore, also in Li_2O , MnO , CaO and SrO , $\text{aluminum}_2\text{O}_3$, and SiO_2 , B in the above-mentioned formula (I) of the magnetic ferrite component used for this invention has MnO , CaO , SiO_2 , and desirable aluminum 2O_3 at the point that a resistance fall is small, also at the time of high-voltage impression, and MnO and CaO are more desirable [B] in respect of a concordance easy with a supply toner especially.

[0041] Next, the edge effect generated when an insulating carrier is used, and the problem of the fall of image concentration are solvable by giving a capacitor component to the front face of the magnetic carrier core material particle shown by the above-mentioned formula (I).

[0042] As this mechanism of action, it is explained as follows. The capacitor layer on the front face of a carrier serves to lower resistance of the whole carrier by migration of the charge inside a layer at the time of alternating current electric-field impression. Therefore, an edge effect is controlled and high image concentration can be obtained. On the other hand, since leak of the charge to the outside of a capacitor layer does not take place, without disturbing an electrostatic latent image, it becomes possible to develop negatives faithfully and is judged as that from which high definition image repeatability without fogging, the remains of leak, or the image defect of carrier adhesion is acquired.

[0043] Less than [more than 10-15F10-11F] is desirable as a value acquired from the applied-voltage frequency dependent of the carrier impedance measured under sine alternating voltage with an amplitude width of 2kV as a capacity of this capacitor component. In the case of below 10-15F, control of a fall of an edge effect or image concentration is inadequate, and when exceeding 10-11F, since the carrier electric resistance under alternating current electric field is too low, it is hard coming to obtain a

highly minute image.

[0044] In addition, about the electrostatic capacity of a carrier, the carrier of electrostatic-capacity 10^{-10} - 2.1×10^{-10} F is indicated in the example and the example of a comparison of JP,4-324457,A.

However, as explained previously, when a carrier with a big capacity more than of 10^{-10} F desirable [of 10^{-15} - 10^{-11} F] and indicated in JP,4-324457,A is used as electrostatic capacity of a carrier, the electric resistance under alternating current electric field falls, and a highly minute image is hard to be obtained according to examination of this invention person.

[0045] Furthermore by this invention person's etc. examination, it became clear for the capacitor component of this carrier core material front face to also enable image reappearance which was very excellent in gradation nature. Although this reason is not yet clear, it can guess as follows.

[0046] Generally, in order for a toner to fly on a latent image, the electrostatic force to the direction of a latent image beyond adsorption power with a carrier is required. Since this sufficient electrostatic force is hard to be acquired in the field where manuscript image concentration is low, i.e., the field where the latent-image potential on a photo conductor is low, the low concentration field of a copy image is lacking in the repeatability of a manuscript image. however, the insulating carrier in connection with this invention -- setting -- the electrification rate of a carrier core material -- quick -- base -- the charge in the capacitor layer on the front face of a carrier charged in reversed polarity with the toner since **** of a quick charge is possible -- base -- it is neutralized quickly and faithful concentration reappearance is attained also in the low concentration field of a manuscript image by mitigating the adsorption power of a toner and a carrier.

[0047] On the other hand, in order that the capacitor layer on the front face of a carrier may reduce resistance of the whole carrier in the field where latent-image potential is high at the time of alternating current electric-field impression, it becomes possible to obtain high image concentration. That is, the copy image which reproduced the manuscript image faithfully over high concentration will be obtained from low concentration.

[0048] Here, the electrical property of a carrier has the desirable bottom of the service condition of a developer, i.e., the development bias condition impressed to a developer at the time of development, as a Measuring condition which changes a lot depending on a Measuring condition, and is closely correlated with a development property. Generally, as impression bias, it is clear at the time of the development for obtaining high definition that the electrical property of the carrier which alternating voltage with the frequency around 2kHz and the amplitude width around 2kV is used in many cases, and is measured under the sine alternating voltage which is an amplitude width of 2kV and the frequency of 2kHz correlates with the development property closely.

[0049] In this invention, although various approaches are mentioned to a carrier core as a means to give a capacitor component to a serial to carrier resistance, ingredients of high resistance, such as resin, are made to distribute the ingredient in which the conductivity by the conduction band (the so-called conduction band) is shown, for example, and there is the approach of coating a carrier front face. However, it is important in the case of coating that a conductive ingredient is not exposed to a cladding material front face, and since carrier resistance falls when there are many exposed parts, it is difficult [it] to obtain a highly minute image.

[0050] Then, it is also one of the desirable means to use the conductive ingredient which performed processing which raises compatibility with the resin to distribute.

[0051] The following can be used as such conductive ingredients. That is, the metallic oxide of carbon black, graphite, the tin oxide, titanium oxide, silicon oxide, the bisumuth oxide, indium oxide, and others etc. is used. As for these, it is also desirable to use it, raising compatibility with the ingredient which serves as distributed support by graft-ized processing or processing by various coupling agents in a front face.

[0052] The following can be used as a cladding material in the case of distributing the above-mentioned conductive ingredient and making a carrier core cover. That is, styrene resin, acrylic resin, other vinyl system polymers and those copolymers, melamine resin, polyamide resin, ionomer resin, polyester resin, an epoxy resin, hardening mold silicone resin, etc. are used. These may be permuted by the halogen

atom etc. in the part.

[0053] For covering to a carrier core, one sort or two sorts or more of the mixture and the polarizability ingredients of a polymer which were shown above can be mixed in a suitable solvent, the charge of a core material can be immersed into the solution obtained, deliquoring, desiccation, the approach of carry out elevated temperature printing, or the charge of a core material can be made to be able to float all over a fluidization floor after an appropriate time, spraying spreading of said copolymer solution can be carried out, and desiccation, the approach of carry out elevated temperature printing, etc. can be used.

[0054] In addition, some are reported until now for the carrier which carried out the coat of the front face by the cladding material which contains a conductive ingredient, for example. For example, it is indicated by JP,4-204551,A, the 5-181322 official report, the 5-241379 official report, etc. as a coat carrier in the cladding material containing carbon black. However, the description about a carrier core material is not made [be / it / under / these official report / setting] at all.

[0055] The carrier using the magnetic carrier core material which has a specific presentation in this invention has attained the Takashina tonality image, and it has become clear for the formation of the Takashina tonality by magnetic carrier core materials other than this to be difficult.

[0056] Moreover, it is indicated by JP,4-360158,A, the 4-372960 official report, the 5-107819 official report, the 5-289412 official report, the 5-303238 official report, etc. also about the coat carrier in the cladding material containing a common conductive ingredient. However, the description about a carrier core material presentation and the carrier electrical property behind a coat is not made, but as point ** was carried out further, the addition to the carrier cladding material of a simple conductive ingredient is directly linked [be / it / under / these official report / also setting] with deterioration of image quality. That is, a conductive ingredient is not exposed from the cladding material front face behind a coat, and only when the capacitor component of the specific range is given to the carrier core material of a presentation restricted further, control of highly minute image reappearance and an edge effect and the coat carrier with which may be further satisfied of all the Takashina tonality are obtained like the carrier in this invention.

[0057] As a ferrite carrier containing MgO, although indicated by JP,2-33159,A, JP,59-111159,A, JP,58-123551,A, JP,55-65406,A, etc., for example, MgO is adopted positively and this inventions of obtaining the copy image of the Takashina tonality with a high definition by grant of a capacitor component in configuration and ideological completely differ further again.

[0058] In this invention, although a carrier and a toner are mixed and a binary system developer is prepared, the point prepared in that case so that this developer may have a specific impedance within the limits and capacitance characteristics is also the big description.

[0059] In order to obtain the Takashina tonality image, controlling problems, such as an edge effect and low image concentration, since a carrier independent twist also has high electric resistance, the developer which generally mixes a carrier with a toner and is obtained is difficult, and also needs to control the electrical property as a developer only by amelioration of a carrier property.

[0060] The result to which this invention person etc. considered the balance of the impedance as a developer, and capacity wholeheartedly, In case said carrier and toner are mixed, the impedance characteristic $1.2 \times 10^8 \text{ ohm}$ and more than cm is shown under an amplitude width of 2 kV , and sine alternating voltage with a frequency of 2 kHz . And by adjusting so that the capacity obtained from the applied-voltage frequency dependent of the impedance measured under sine alternating voltage with an amplitude width of 2 kV may have a value not more than 10^{-14} F to 10^{-11} F It became clear that the developer which gives the Takashina tonality image without an edge effect by high image concentration was obtained.

[0061] Here, if less than $1.2 \times 10^8 \text{ ohm-cm}$ or capacity exceeds [the impedance of a developer] 10^{-11} F , in order for the electric resistance property of the developer under alternating current electric field to fall, the image quality fall of a copy image will take place. Moreover, when capacity is less than [10^{-14} F], it becomes difficult to prevent the fall of an edge effect or image concentration.

[0062] In addition, although there is no limit the mean particle diameter of the insulating carrier in this invention was decided to be, especially in the case of 50 micrometers or less, the above-mentioned

effectiveness becomes remarkable. In case carrier surface area becomes large and it mixes with a toner so that carrier particle size generally becomes small, the electrification rate of a toner becomes quick. Since surface area becomes large [the area which carrier contamination of only a large part generates] on the other hand, variation arises in electrification of each toner by use of long duration. In that case, variation will arise also in the electrostatic force received from latent-image electric field, and the gradation nature of a copy image will be spoiled. However, in the insulating carrier in this invention, since the adsorption power of a toner and a carrier is mitigated, even if it uses a carrier with a small particle size, the gradation nature in long duration use order is maintained highly, and a good result is obtained according to the development of the amount of toners which always balances latent-image potential being possible.

[0063] Moreover, although there is no limit decided to be also the toner mean particle diameter in the developer in this invention, especially in the case of 8 micrometers or less, it is very a high definition, and the image of the Takashina tonality is stabilized over a long period of time, and it is obtained.

[0064] although the image generally obtained, so that the mean particle diameter of a toner becomes small will also become high definition -- each toner particle -- homogeneity -- and base -- it becomes difficult for you to make it charged quickly. Therefore, when the electrification property of the carrier in a developer changes with use of long duration, the variation in electrification of each toner also tends to become large.

[0065] However, when a toner with a small particle size is applied to the developer configuration of this invention, the electrification grant ability of a carrier is high, and turns into that it is possible to obtain the image of a high definition and the Takashina tonality from the time of the beginning of using to stability over long duration by the Takashina tonality being always maintainable.

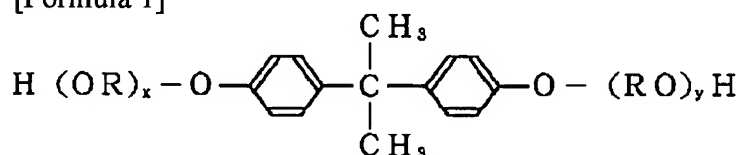
[0066] That is, if a carrier 50 micrometers [or less] and a toner 8 micrometers or less are used according to the developer configuration of this invention, the high-definition image of the high definition as which an edge effect is not regarded by high image concentration, and the Takashina tonality will be obtained over a long period of time, without spoiling endurance.

[0067] As binding resin for toners in the developer of this invention, various kinds of ingredient resin conventionally known as toner binding resin for electrophotography is used. For example, they are styrene system copolymers, such as polystyrene, a styrene butadiene copolymer, and a styrene acrylic copolymer, polyethylene, an ethylene-vinylacetate copolymer, an ethylene system copolymer like an ethylene-vinylalcohol copolymer, phenol system resin, epoxy system resin, acrylic phthalate resin, polyamide resin, polyester resin, maleic-acid system resin, etc. Moreover, especially as for the manufacture approach etc., neither of the resin is restrained.

[0068] When the high polyester system resin of especially negative electrification ability is used in these resin, the effectiveness of this invention is greatest. That is, while polyester system resin is excellent in fixable and fits the color toner, electrification tends to become [negative electrification ability] strong excessively, but if polyester resin is used for the configuration of this invention, evil will improve and the outstanding toner will be obtained.

[0069] Especially, it is a degree type [0070].

[Formula 1]



[0071] (-- for the inside R of a formula, it is ethylene or a propylene radical, and x and y are one or more integers, respectively, and the average values of x+y are 2-10.) -- since it has a melting property with the sharp polyester resin which used the bisphenol derivative or substitution product represent as the diol component, and carried out co-condensation polymerization of the carboxylic-acid components (for example, a fumaric acid, a maleic acid, a maleic anhydride, a phthalic acid, a terephthalic acid, trimellitic acid, pyromellitic acid) which consist of the carboxylic acid, its acid anhydride, or its low-

grade alkyl ester more than divalent, it is more desirable.

[0072] conventionally independent [in well-known dyes and pigments, such as carbon black, lamp black, iron black, ultramarine blue, the Nigrosine color, the aniline blue, a copper phthalocyanine blue, Phthalocyanine Green, Hansa yellow G, rhodamine 6G, KARUKO oil blue, chrome yellow, Quinacridone, benzidine yellow, a rose bengal, a thoria reel methane system color monoazo, and JISUAZO system dyes and pigments,] as a coloring agent used for the toner in the developer of this invention -- or it can be used, mixing.

[0073] Moreover, a flow improver may be added in order to raise a fluidity to the toner in the developer of this invention.

[0074] Anythings are usable, if a fluidity compares addition order by adding to a toner as a flow improver used for this invention and it may increase.

[0075] For example, the surface treatment metallic oxide which performed surface treatment by the silane coupling agent, the titanium coupling agent, silicone oil, etc. is in, such as calcium stearate, or fatty-acid metal salts, i.e., zinc stearates, such as fluororesin powder, i.e., vinylidene fluoride impalpable powder, and polytetrafluoroethylene impalpable powder, and lead stearate, or a metallic oxide, i.e., zinc oxide powder, titanium oxide impalpable powder, silica impalpable powder, alumina impalpable powder, and these metallic oxides.

[0076] Next, the image formation approach of this invention is explained.

[0077] The inside of the magnet roller built in developer support and this in this invention, Rotate both a magnet roller and developer support, or fix a magnet roller and developer support is rotated. Carry out circulation conveyance of the binary system developer which contains a carrier and a toner at least on developer support, and in the development field of a latent-image supporter and the developer support which counters it In the image formation approach which imprints the toner image which developed the latent image with the toner and was formed on the latent-image supporter on imprint material This binary system developer is the above-mentioned developer, the mutual electric field which have the alternating current component and the dc component in this development field are formed, and it is also the further description to develop a latent image on the conditions whose frequency nukHz(es) of this mutual electric field are $1.0 \leq \nu$.

[0078] That is, the above-mentioned developer becomes more remarkable [the depressor effect of an image concentration fall and an edge effect] by combining with the development approach of developing a latent image on the conditions whose frequency nukHz(es) of mutual electric field are $1.0 \leq \nu$, when the electrostatic-capacity component has especially the operation which negates the evil by high resistance of an edge effect etc. in the bottom of the mutual electric field of high frequency. In the case of $\nu < 1.0$, image concentration becomes lowness a little and it becomes the image with which an edge effect is also conspicuous a little.

[0079] Moreover, it is more desirable that the above-mentioned development approach is the development approach of developing a latent image with a toner by making a toner flying to the image section and impressing the electrical potential difference of the direction which pulls back a toner to the non-image section after impressing the electrical potential difference which draws a toner near to developer support from a latent-image supporter between a latent-image supporter and developer support, and the electrical potential difference which makes it flying from developer support to a latent-image supporter once [T / at least] for 1 hour.

[0080] Preferably especially rather than the sum total time amount (T1) which impresses the 1st electrical potential difference which makes a toner go to developer support from the above-mentioned latent-image supporter, and the 2nd electrical potential difference which makes a toner go to a latent-image supporter from developer support to developer support It is desirable especially in order for lengthening time amount (T2) which impresses the 3rd electrical potential difference between this 1st electrical potential difference and this 2nd electrical potential difference to developer support to carry out the rearrangement of the toner and to reappear to a latent image faithfully on a latent-image supporter.

[0081] In a development field, after forming the electric field by which a toner goes to developer support

from a latent-image supporter between a latent-image supporter and developer support, and the electric field by which a toner goes to a latent-image supporter from developer support once [at least], specifically In the image section of a latent-image supporter, a toner goes to a latent-image supporter from developer support. In the non-image section of a latent-image supporter It is what develops the latent image currently held at the latent-image supporter by carrying out predetermined time formation of the electric field by which a toner goes to developer support from a latent-image supporter with the toner of the binary system developer currently supported by developer support. In the image section of a latent-image supporter, a toner goes to a latent-image supporter from developer support from the sum total time amount (T1) which forms the electric field by which a toner goes to a latent-image supporter from the electric field by which a toner goes to developer support from this latent-image supporter, and developer support. In the non-image section of a latent-image supporter, it is desirable to lengthen the time amount (T2) which forms the electric field by which a toner goes to developer support from a latent-image supporter.

[0082] this invention persons found out that the binary system developer of this invention with a specific electric resistance property was used, and high definition-ization which does not have carrier adhesion, either and was excellent with high image concentration and highly minute image repeatability when negatives were developed using the development electric field which turn off alternation periodically by the development approach of forming and developing an alternating electric field could be attained.

[0083] When the carrier which has the specific electric resistance property and serves as a constituent like the above-mentioned also has a specific presentation, the standup of frictional electrification nature with a toner of the binary system developer of this invention is also good, and when it consists of toners which consist of a carrier and the mean particle diameter of 8 micrometers or less with especially the mean particle diameter of 50 micrometers or less, the very high definition image reappearance of it is attained.

[0084] In one side, although it is just going to worry about carrier adhesion of a up to [a latent-image supporter] at the time of development when particle size is a small carrier, carrier adhesion is not generated by combining with the development electric field described in this invention. Although this reason is not yet clear, it thinks as follows.

[0085] That is, in a continuous conventional sine wave or a conventional continuous square wave, if it is going to attain high-definition concentration and field strength is strengthened, although between a latent-image supporter and developer support is reciprocated in one and a highly minute image is obtained, a carrier will carry out rubbing of a toner and the carrier to a latent-image supporter strongly as a result, and carrier adhesion will generate them. It is so remarkable that this inclination has many fines carriers.

[0086] However, if the specific alternating current electric field like this invention are impressed, in order that a toner or a carrier may carry out the reciprocating motion which has not gone back and forth between developer support and a latent-image supporter by one pulse, Although it works at the time of the subsequent 3rd electrical-potential-difference impression so that V_{cont} may make a carrier fly from developer support when the potential difference V_{cont} of the surface potential of a latent-image supporter and the dc component of development bias is $V_{cont} < 0$ Carrier adhesion can be prevented by controlling the magnetic properties of a carrier, and the flux density in the development field of a magnet roller. In the case of $V_{cont} > 0$ It works so that the force and V_{cont} of a field may draw a carrier to a developer support side, and carrier adhesion is not generated.

[0087] The measuring method in this invention is described below.

[0088] 1) Explain the measuring method measuring method of the amount of frictional electrifications in full detail using a drawing.

[0089] Drawing 1 is the explanatory view of the equipment which measures the TORIBO charge of a toner. First, about 0.5-0.9g of developers extracted from the sleeve of a development counter is put into the metal measurement container 12 which has the screen 13 of 500 meshes in a bottom, and it is covered with the metal free wheel plate 14. Weight of the measurement container 12 whole at this time is made into **** W1 (g). Next, in the suction machine 11 (the part which touches the measurement

container 12 is an insulator at least), it draws in from the suction opening 17, the airflow control valve 16 is adjusted, and the pressure of a vacuum gage 15 is set to 250mmAq(s). In this condition, suction is performed for about 2 minutes sufficiently preferably, and suction removal of the toner is carried out. Potential of the electrometer 19 at this time is set to V (volt). 18 is a capacitor and sets capacity to C (micro F) here. Moreover, weight of the whole measurement container after suction is made into **** W2 (g). The amount (mC/kg) of frictional electrifications of this toner is calculated like a bottom type. [0090] Amount (mC/kg) of frictional electrifications = (CxV)/of a toner (W1-W2)

2) Measurement of measuring method fogging of fogging is REFLECTOMETER by Tokyo Denshoku Co., Ltd. It measured using MODELTC-6DS, and by the cyanogen toner image, the amber filter was used and it computed from the following formula. There is so little fogging that a numeric value is small.

[0091] The reflection factor of the non-image section of the reflection factor (%) - sample of fogging (reflection factor) (%) = standard paper (%)

3) The magnetic properties of three to physical-properties value measurement 1 carrier of a carrier were performed using the BHU-60 mold magnetization measuring device (product made from the Riken measurement).

[0092] About 1.0g weighing capacity of the test portion is carried out, and it is set to bore 7mmphi and a cel with a height of 10mm at a click and above equipment. Measurement adds an impression magnetic field gradually and is changed up to a maximum of 3,000 oersted. Subsequently, impression magnetic fields are made to decrease in number, and, finally the hysteresis curve of a sample is obtained in the record paper. From this, saturation magnetization, residual magnetization, and coercive force are searched for.

[0093] 3-2) As a measuring device of the particle size distribution of a carrier, the SRA type of a micro truck grading-analysis meter (Nikkiso Co., Ltd.) was used, and it carried out by 0.7-125-micrometer range setup.

[0094] 3-3) Measurement of the impedance of a coat carrier and a developer was measured using the cel shown in drawing 2. That is, Cel A was filled up with the sample, electrodes 21 and 22 were arranged so that this restoration sample 27 might be touched, sine alternating voltage was impressed to this inter-electrode one, and it asked by measuring the current which flows then with the ammeter 24 for an alternating current. The Measuring condition is 15kg pile of loads of 2 and thickness of d= 3mm with a touch area [with the cel of a restoration sample] of S= 2cm, and an up electrode, and the value of the impedance in that case is acquired from alternating-voltage amplitude width / current value xS/d.

[0095] 3-4) The electrostatic capacity of a coat carrier and a developer is the following, and was made and calculated.

[0096] In measurement of the impedance indicated to the above 3-3, in case sine alternating voltage with an amplitude width of 2kV is impressed between an electrode 2 and 22, the frequency is suitably changed in 0-4kHz, and an alternating current current value is read by a total of 24 each time. Next, it is 2 (impedance) based on the obtained data. The graph of vs.(frequency)-2 is created and it asks for inclination a. Electrostatic capacity C (F) inclines and uses the value of a, $C = (2\pi\sqrt{a})^{-1}$ (π : 円周率)

It asked more.

[0097] 4) After using the manuscript image which has on an image the image part which shows the Macbeth concentration of 0.50, and 1.00 and 1.50 at 25% of rates of evaluation image surface ratio of the gradation nature of a copy image and measuring the image concentration of the homotopic of the obtained copy image, correlation of the concentration of a manuscript image and its copy image was found. In this case, it means that gradation nature is so high that the functionality of concentration is close to the primary straight line as shown in drawing 3.

[0098]

[Example] Although the example of this invention is shown below, this invention is not limited to this at all. The "section" means the "weight section."

[0099] (Examples 1 and 2 of manufacture of a carrier core material particle) MgO The 20 sections, MnO

The 20 sections, Fe 2O₃ After carrying out addition mixing and coming water after atomizing the 60 sections, respectively, the mean particle diameter of 36 micrometers and the 58-micrometer ferrite carrier core material particles (saturation magnetization 58Am²/kg) A and B as calcinated at 1100 degrees C and shown in Table 1 were obtained, respectively.

[0100] (Example 3 of manufacture of a carrier core material particle) MgO The 15 sections, MnO The 15 sections, SiO₂ The three sections, Fe 2O₃ The 67 sections were used and the ferrite carrier core material particle (saturation magnetization 60Am²/kg) C with a mean particle diameter of 38 micrometers was obtained like the example 1 of manufacture except calcinating at 1300 degrees C.

[0101] (Example 4 of manufacture of a carrier core material particle) MgO The three sections, CaO The five sections, Fe 2O₃ The ferrite carrier core material particle (saturation magnetization 65Am²/kg) D with a mean particle diameter of 41 micrometers was obtained like the example 3 of manufacture except using the 92 sections.

[0102] (Example 5 of manufacture of a carrier core material particle) MgO The 20 sections, aluminum 2O₃ The five sections, Fe 2O₃ The ferrite carrier core material particle (saturation magnetization 57Am²/kg) E with a mean particle diameter of 43 micrometers was obtained like the example 3 of manufacture except using the 75 sections.

[0103] (Example 6 of manufacture of a carrier core material particle) NiO The 15 sections, CoO The 15 sections, Fe 2O₃ The ferrite carrier core material particle (saturation magnetization 67Am²/kg) F with a mean particle diameter of 42 micrometers was obtained like the example 3 of manufacture except using the 70 sections.

[0104] (Examples 1-10 of manufacture of a carrier) In the toluene-methyl-ethyl-ketone-butanol-water mixed solvent 100 section, it added and the ten sections and carbon black were mixed so that it might become the 0.1 sections, and hardening mold silicone resin produced the carrier covering solution. With the spreading machine (Okada elaborate company make: Spira Cota), this covering solution was applied so that the amount of resin coats might become the above-mentioned carrier core material A with the one section to a carrier core material, and the carrier 1 was obtained.

[0105] The carriers 1-10 as changed an additive and resin and hereafter shown in Table 1 were obtained.

[0106]

[Table 1]

表1

番号 No.	コア材 No.	組成 (重量部)	飽和磁化 (Am ² /kg)	粒径 (μm)	被覆材 { 添加剤,部数 (vs. 樹脂) 樹脂,部数 (vs. コア材)	キャリア 静電容量 (F)
1	B	MgO - MnO - Fe ₂ O ₃ (18) (22) (80)	56	58	カーボンブラック , 1 部 硬化型シリコーン樹脂 , 1 部	4 × 10 ⁻¹²
2	A	MgO - MnO - Fe ₂ O ₃ (18) (22) (80)	56	36	グラフト処理カーボンブラック , 2 部 硬化型シリコーン樹脂 , 1.5 部	2 × 10 ⁻¹²
3	A	MgO - MnO - Fe ₂ O ₃ (18) (22) (80)	56	36	脂肪酸亜鉛処理 SnO ₂ , 1 部 硬化型シリコーン樹脂 , 1.5 部	3 × 10 ⁻¹²
4	A	MgO - MnO - Fe ₂ O ₃ (18) (22) (80)	56	36	カーボンブラック , 1 部 フッ化ビニリデン-テトラフルオロエチレン 共重合体+メチルメタクリレート-ブチルアクリ レート共重合体 (1:1) , 2部	1 × 10 ⁻¹²
5	A	MgO - MnO - Fe ₂ O ₃ (18) (22) (80)	56	36	カーボンブラック , 10 部 硬化型シリコーン樹脂 , 1.5 部	8 × 10 ⁻¹⁰
6	A	MgO - MnO - Fe ₂ O ₃ (18) (22) (80)	56	36	カーボンブラック , 0.1 部 硬化型シリコーン樹脂 , 1.5 部	2 × 10 ⁻¹¹
7	C	MgO - MnO - SiO ₂ - Fe ₂ O ₃ (20) (20) (3) (57)	59	38	カーボンブラック , 1 部 硬化型シリコーン樹脂 , 1.5 部	3 × 10 ⁻¹²
8	D	MgO - CaO - Fe ₂ O ₃ (4) (5) (91)	62	41	カーボンブラック , 1 部 硬化型シリコーン樹脂 , 1.5 部	9 × 10 ⁻¹⁴
9	E	MgO - Al ₂ O ₃ - Fe ₂ O ₃ (20) (8) (72)	56	43	カーボンブラック , 1 部 硬化型シリコーン樹脂 , 1.5 部	8 × 10 ⁻¹⁴
10	F	NiO - CoO - Fe ₂ O ₃ (15) (15) (70)	67	42	カーボンブラック , 1 部 硬化型シリコーン樹脂 , 1.5 部	1 × 10 ⁻¹²

[0107]

(Example 1 of manufacture of a toner)

A propoxy-ized bisphenol and fumaric acid The 100 sections Polyester resin obtained by condensing Phthalocyanine pigment The four sections Chromium complex of a G tert-butyl salicylic acid The four sections [0108] The Henschel mixer performed preliminary mixing enough, melting kneading was carried out with the 2 shaft extrusion type kneading machine, and coarse grinding of the above-mentioned raw material was carried out to about 1-2mm using the hammer mill after cooling, and, subsequently it was pulverized with the pulverizer by the air jet method. The pulverizing object furthermore obtained was classified and the fine particles of the cyanogen color of the negative frictional electrification nature whose weighted mean particle size is 8.5 micrometers were obtained.

[0109] The coloring fine-particles 100 above-mentioned section and the titanium oxide impalpable powder (product T805 made from Japanese Aerosil) 1.0 section were mixed with the Henschel mixer, and the cyanogen toner 1 was obtained.

[0110] (Example 2 of manufacture of a toner) The cyanogen toner 2 was obtained like the example 1 of manufacture of a toner except using the alumina impalpable powder which set weighted mean particle size to 6.0 micrometers, and carried out hydrophobing processing of the front face by the silane coupling agent instead of titanium oxide impalpable powder.

[0111] The cyanogen toner 2 and carrier 2 of the example 1 above-mentioned were mixed so that the toner concentration in a developer might become 6 % of the weight, and it considered as the developer. From the obtained developer, the value of impedance 1.5x10⁸ ohm-cm and electrostatic-capacity 4x10⁻¹⁴F was acquired. The discontinuous alternating electric field shown in drawing 5 by connection with an external power as bias for development was impressed using the color copying machine CLC700 (Canon make), and evaluation of 30,000 sheets depended for ****(ing) was performed by development contrast 300V using the original manuscript of 30% of rates of image surface ratio under 20 degrees C / 10% of temperature and humidity. The obtained result is shown in Table 2.

[0112] The above-mentioned developer was excellent in gradation nature 30,000 sheets after the first stage, and gave the high definition image with which an edge effect is not seen, either so that more clearly than Table 2. Moreover, the amount of electrifications also changed to stability, there was also

little fogging and dirt inside the plane was not seen, either.

[0113] In addition, the following examples and examples of a comparison were also similarly shown in Table 2.

[0114] Except impressing the mutual electric field shown in drawing 4 as bias for example 2 development, when the same evaluation as an example 1 was performed, there is no problem especially on image quality 30,000 sheets after the first stage, and the image also with good gradation nature was obtained . The amount of electrifications also changed to stability and fogging and especially dirt inside the plane did not have a problem, either.

[0115] Except impressing the mutual electric field shown in drawing 6 as bias for example 3 development, when the same evaluation as an example 1 was performed, especially although the edge effect was slightly seen 30,000 sheets after the first stage, the satisfactory image was obtained. The amount of electrifications also changed to stability and especially the problem had neither image quality, gradation nature, fogging and dirt inside the plane nor all.

[0116] The example 4 cyanogen toner 1 and the carrier 2 were mixed so that the toner concentration in a developer might become 8 % of the weight, and it considered as the developer. When the same evaluation as an example 1 was performed using this developer, it excelled in gradation nature 30,000 sheets after the first stage, and the image of very good image quality without an edge effect was obtained. The amount of electrifications also changed to stability, there was also little fogging and dirt inside the plane was not seen, either.

[0117] The example 5 cyanogen toner 1 and the carrier 2 were mixed so that the toner concentration in a developer might become 5 % of the weight, except considering as a developer, when the same evaluation as an example 1 was performed, the edge effect could be seen 30,000 sheets after the first stage, and the image with very good ****, image quality, and gradation nature was obtained. The amount of electrifications also changed to stability, there was also little fogging and dirt inside the plane was not seen, either.

[0118] Except using carriers 3 and 4, or 7-9 as six to example 10 carrier, when the same evaluation as an example 1 was performed, as shown in Table 2, in any case, it excelled in gradation nature 30,000 sheets after the first stage, and the high definition image with which an edge effect is not seen, either was given. Moreover, the amount of electrifications also changed to stability, there was also little fogging and dirt inside the plane was not seen, either.

[0119] Other than mixing the example of comparison 1 cyanogen toner 2, and a carrier 2 so that the toner concentration in a developer may become 15 % of the weight, and considering as a developer, when the same evaluation as an example 1 was performed, only the image whose level of image quality is not good was obtained 30,000 sheets after the first stage, and gradation nature was not good, either. Since the impedance of a developer is small, an electrostatic latent image is considered that turbulence and image quality deteriorated. In addition, the edge effect did not have especially the problem.

[0120] The example of comparison 2 cyanogen toner 1 and the carrier 1 were mixed so that the toner concentration in a developer might become 1.5 % of the weight, and except considering as a developer, when the same evaluation as an example 1 was performed, only the image with which an edge effect is seen 30,000 sheets after the first stage and which is not good as for gradation nature was obtained. This has the small electrostatic capacity of a developer and is considered because an edge effect cannot be controlled.

[0121] When it replaced with example of comparison 3 carrier 2 and the same evaluation as an example 1 was performed using the carrier 5, only the image with which the edge effect of what has good image quality is seen and which is not good as for gradation nature was obtained. This is also considered because the electrostatic capacity of a carrier and a developer is small.

[0122] When it replaced with example of comparison 4 carrier 2 and the same evaluation as an example 1 was performed using the carrier 6, only the image which is not good as for image quality was obtained 30,000 sheets after the first stage. Since this has the large electrostatic capacity of a developer, an electrostatic latent image is considered that turbulence and image quality deteriorated. In addition, there was especially no problem about an edge effect and fogging.

[0123] Although the high definition copy image with which it excels in gradation nature the first stage, and an edge effect is not seen was obtained when it replaced with example of comparison 5 carrier 2 and the same evaluation as an example 1 was performed using the carrier 10, the amount of electrifications fell sharply and aggravation and the dirt inside the plane of fogging were seen 30,000 sheets after. This may be based on the quality of the material in which the presentation of a carrier core material is inferior to electrification endurance.

[0124]

[Table 2]

表2

	現 像 剤 特 性						初 期 特 性							20℃/10%下8万枚耐久後									
	番号 No.	トナー Na	トナー濃度 (wt%)	イビツクス (Ω・cm)	静電容量 (F)		現像用ノズル	イビツクス効果の抑制	画質	帯電量 (nC/kg)	歩行 (%)	複写画像濃度 (原稿画像濃度)			イビツクス効果の抑制	画質	帯電量 (nC/kg)	歩行 (%)	複写画像濃度 (原稿画像濃度)			機内汚染	
												0.50	1.00	1.50					0.50	1.00	1.50		
実施例 1	2	2	6	1.5×10 ⁴	4×10 ⁻¹⁴	図5	◎	◎	-29	0.2	0.51	0.99	1.51	◎	◎	-28	0.4	0.52	1.01	1.53	◎		
実施例 2	2	2	6	1.5×10 ⁴	4×10 ⁻¹⁴	図4	◎	○	-29	0.7	0.46	0.92	1.46	◎	○	-28	0.9	0.48	0.93	1.47	◎		
実施例 3	2	2	6	1.5×10 ⁴	4×10 ⁻¹⁴	図6	○	○	-29	0.9	0.44	0.90	1.41	○	○	-28	1.0	0.45	0.92	1.43	◎		
実施例 4	2	1	8	1.4×10 ⁴	9×10 ⁻¹⁴	図5	◎	◎	-27	0.3	0.55	1.09	1.71	◎	◎	-26	0.5	0.57	1.10	1.72	◎		
実施例 5	1	1	5	1.8×10 ⁴	3×10 ⁻¹⁴	図5	◎	◎	-28	0.2	0.45	0.91	1.38	◎	◎	-26	0.5	0.46	0.93	1.40	◎		
実施例 6	3	2	6	2.0×10 ⁴	3×10 ⁻¹⁴	図5	◎	◎	-27	0.3	0.49	1.01	1.53	◎	◎	-25	0.6	0.52	1.04	1.58	◎		
実施例 7	4	2	6	1.3×10 ⁴	8×10 ⁻¹⁴	図5	◎	◎	-26	0.3	0.52	1.02	1.55	◎	◎	-24	0.5	0.55	1.05	1.60	○		
実施例 8	7	2	6	2.1×10 ⁴	3×10 ⁻¹⁴	図5	◎	◎	-28	0.2	0.48	0.97	1.49	◎	◎	-27	0.5	0.50	0.99	1.51	◎		
実施例 9	8	2	6	2.3×10 ⁴	2×10 ⁻¹⁴	図5	◎	◎	-25	0.4	0.56	1.18	1.57	◎	◎	-24	0.7	0.59	1.22	1.67	◎		
実施例10	9	2	6	2.6×10 ⁴	1×10 ⁻¹⁴	図5	○	◎	-27	0.3	0.47	0.90	1.39	○	◎	-25	0.6	0.51	0.99	1.49	◎		
比較例 1	2	2	15	9×10 ⁴	8×10 ⁻¹⁴	図5	◎	△	-22	0.7	0.71	1.25	1.66	○	△	-20	0.9	0.77	1.30	1.69	△		
比較例 2	1	1	1.5	2.9×10 ⁴	9×10 ⁻¹⁴	図5	△	○	-34	0.2	0.12	0.31	0.64	△	×	-33	0.4	0.11	0.28	0.55	◎		
比較例 3	5	2	6	3.3×10 ⁴	8×10 ⁻¹⁴	図5	△	◎	-22	0.8	0.21	0.64	0.88	△	○	-21	1.1	0.23	0.66	1.01	△		
比較例 4	6	2	6	1.2×10 ⁴	2×10 ⁻¹⁴	図5	◎	△	-28	0.2	0.62	1.37	1.72	○	×	-26	0.5	0.64	1.40	1.76	○		
比較例 5	10	2	6	2.2×10 ⁴	5×10 ⁻¹⁴	図5	◎	◎	-30	0.9	0.48	1.02	1.53	○	△	-18	2.1	0.67	1.45	1.89	×		

表中基準判断 ◎：非常に良好， ○：実用上問題無し， △：実用上問題有り， ×：使用不可

[0125]

[Effect of the Invention] The capacitor component of a specific capacity is given to the ferrite core material which consists of a specific presentation, and the carrier of this invention becomes possible [obtaining the high definition high image of gradation nature] by giving a specific impedance characteristic and a specific electrostatic-capacity property to the binary system developer of this invention further constituted with this carrier and a toner, controlling an edge effect.

[Translation done.]